FS WEPP
Forest Service Interfaces for the Water Erosion Prediction Project Computer Model

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🔺 Introduction

FS WEPP is a set of interfaces designed to allow users to quickly evaluate erosion and sediment delivery potential from forest roads. The erosion rates and sediment delivery are predicted by the Water Erosion Prediction Project (WEPP) model, using input values for forest conditions developed by scientists at the Rocky Mountain Research Station.

The initial FS WEPP screen (Figure 1) provides users with the option to select the X-DRAIN program, the WEPP:Road program, or the weather data generator, Rock:Clime.
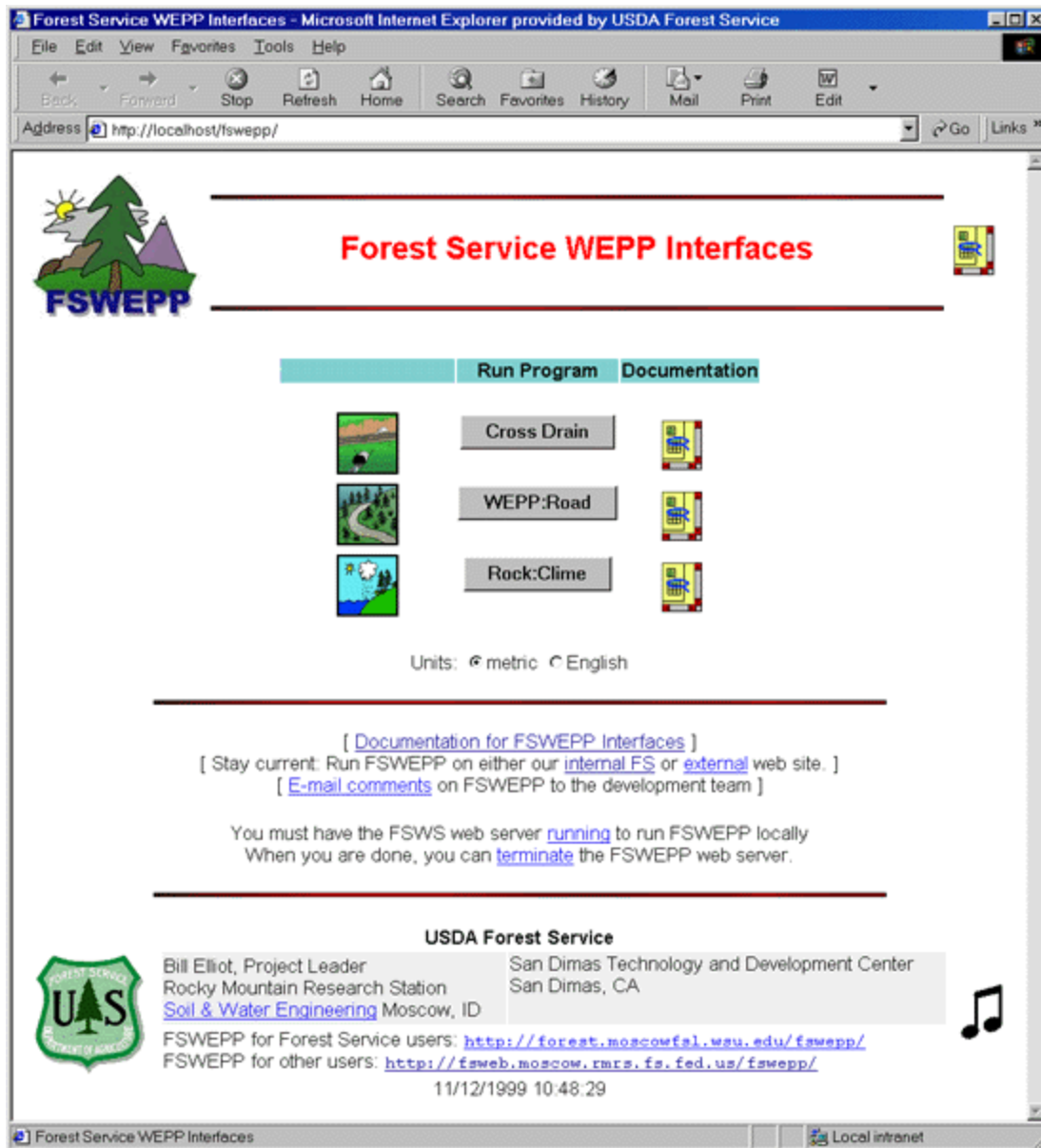
Figure 1. *FS WEPP Initial Screen*

The accuracy of the predicted values from X-DRAIN and WEPP:Road are, at best, within plus or minus fifty percent. True erosion rates are highly variable due to large variations in local topography, climate, soil properties, and vegetative properties, so predicted values are only a single estimate of a highly variable process.

X-DRAIN

The Cross Drain program, or X-DRAIN, is a simple interface to access the predicted sediment yields from about 130,000 WEPP runs. X-DRAIN is based on three overland flow elements consisting of a road, a fill slope, and a forested buffer.
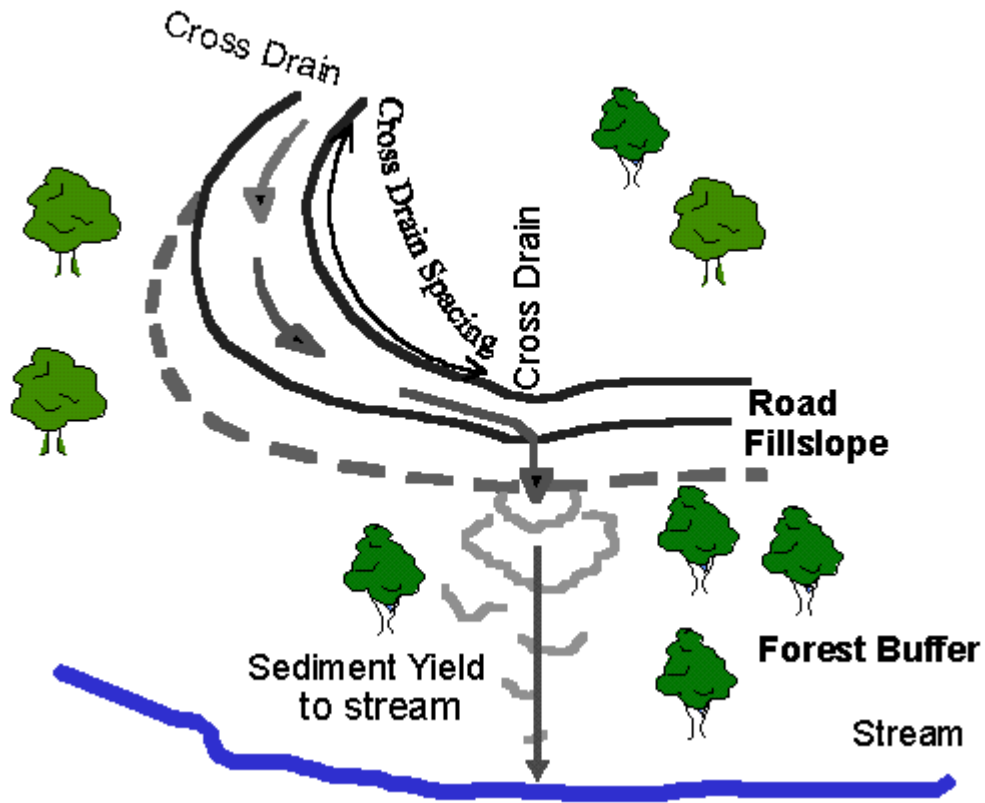
Figure 2. *Template for X-DRAIN Program*

With X-DRAIN, the user selects from one of 82 climates, one of five soils, one of four buffer slope steepness values, and one of five buffer lengths on the input screen (Figure 3). The sediment yield from the buffer is then presented on the results screen for 20 different sets of road gradient and cross drain spacing values (Figure 4). For example, in Figure 4, the sediment yield is 167 kg for a 60-m long road with a 4% gradient.

Figure 3. *X-DRAIN Input Screen*
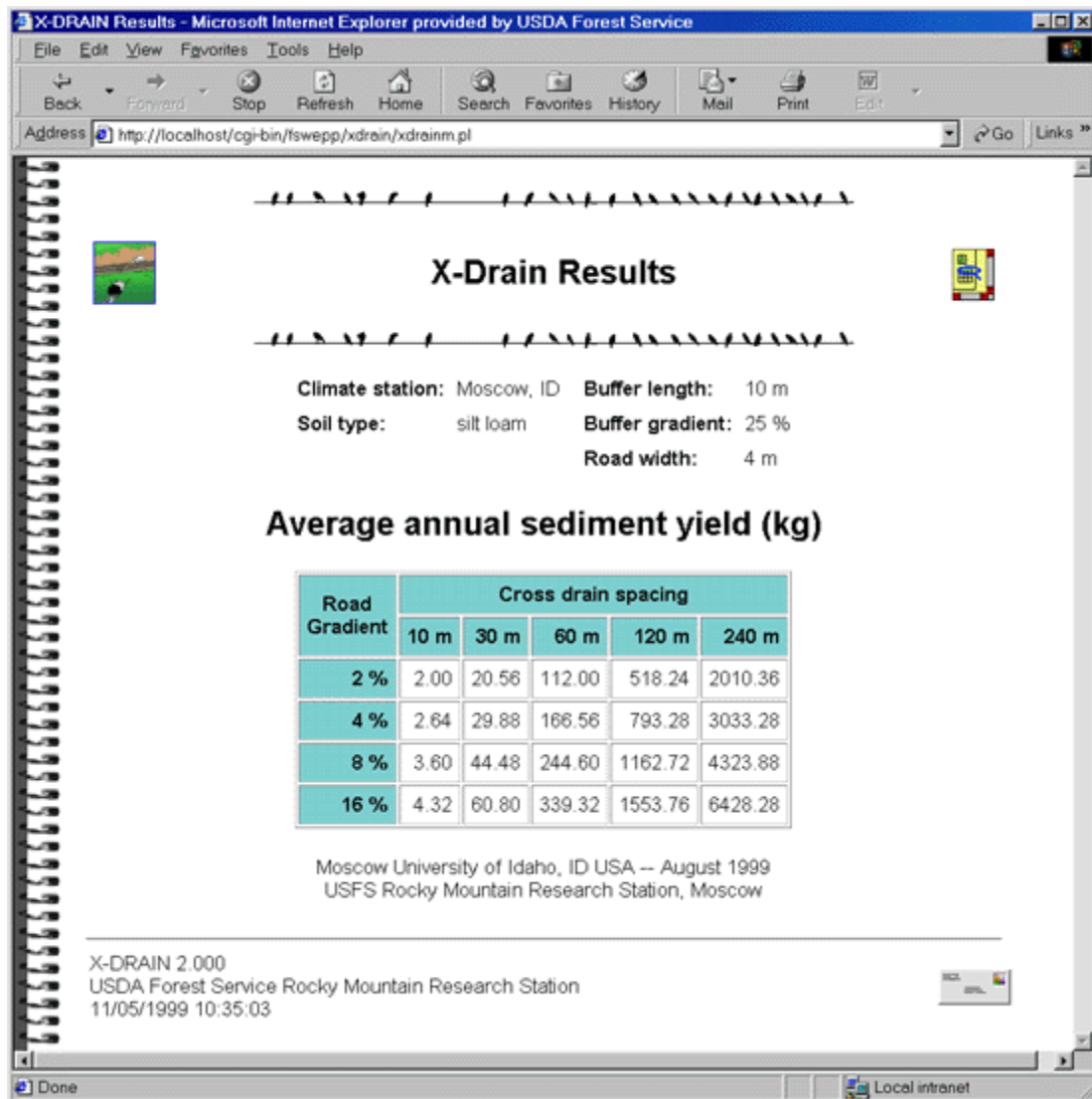
Figure 4. *X-DRAIN Results Screen*

X-DRAIN is useful for determining sediment yields for typical road networks to aid in road design, watershed sediment analysis, and road closure activities. It can also be applied to log landings, parking lots, and compacted trails from skidding or recreation.

⬣ WEPP:Road

X-DRAIN is useful for making rapid assessment of the sediment potential from a road network. In some cases, greater site details are known, or the input options offered by X-DRAIN are not adequate. For these conditions, the WEPP:Road interface was developed. Like X-DRAIN, it describes the conditions shown in Figure 2, and has an input and a results screen.

On the WEPP:Road input screen, the user can select from the short list of climates, but will likely prefer to generate a custom climate with the Rock:Clime interface to the CLIGEN weather generator. After a climate is selected, the user can select a soil, specify the road surface condition, and specify the road and buffer topographic features for slope steepnesses ranging from near zero to 100 percent, and lengths ranging from 1 m to 300 m. The user can specify the number of years of run. At least 30 years are recommended, and 50 to 100 years is preferable for climates with rainfall below 500 mm. Users must also specify the road design, select the appropriate road width and specify the presence of gravel.

Figure 5. *WEPP:Road Input Screen*

The output from WEPP:Road presents not only the amount of sediment delivered from the forest buffer to a stream, but also the average precipitation, the runoff, and the amount of sediment leaving the eroding portion of the road prism. For example Figure 6 shows that for the specified conditions, the average annual values are: precipitation, 640 mm; total runoff, 0 mm; sediment leaving the road, 192 kg; and sediment delivered to the stream some 40 m below the road, 4 kg.

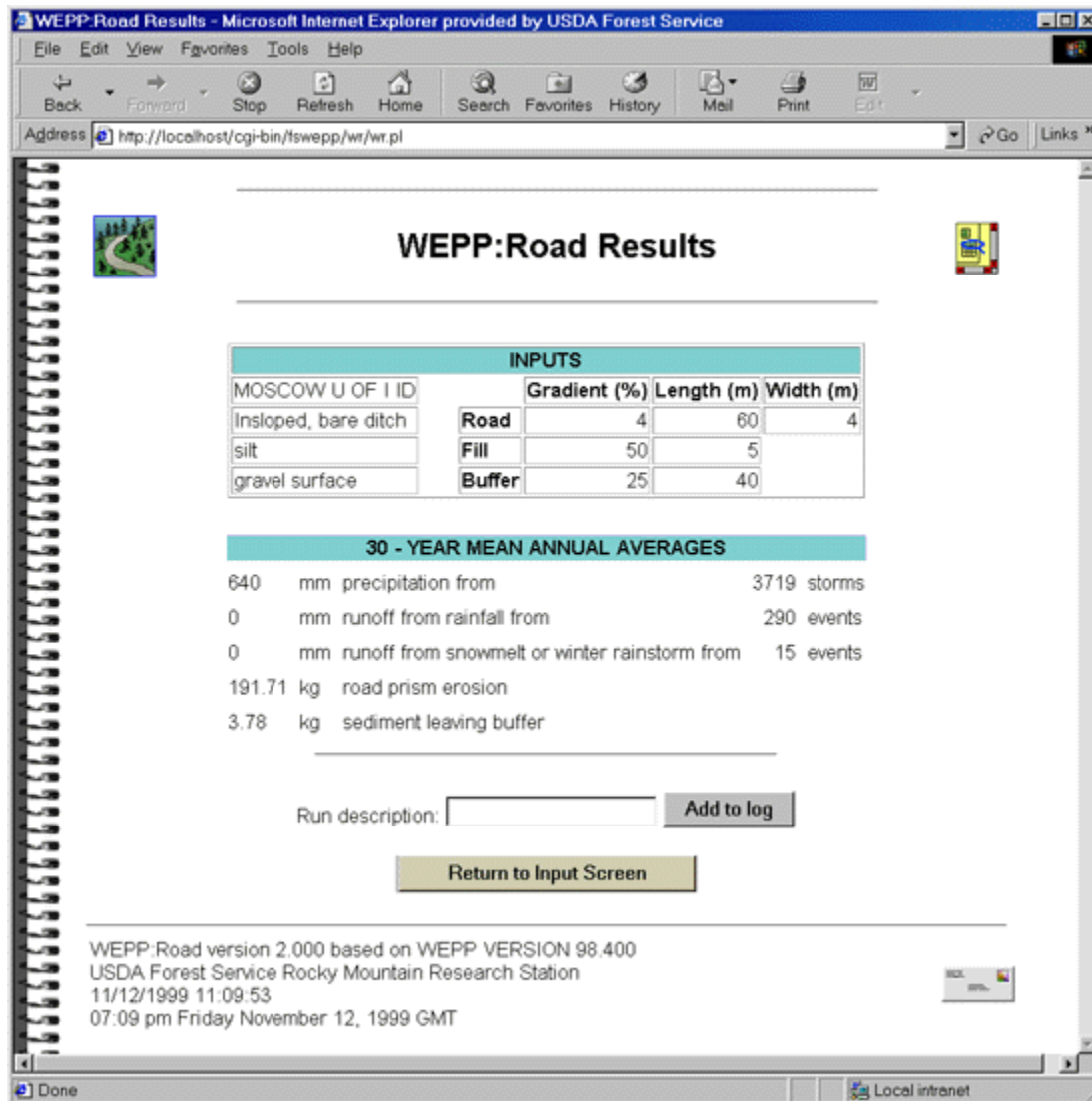**Figure 6.** *WEPP:Road Results screen*

The results from numerous runs of WEPP:Road can be added to a log file (Figure 7) for saving or printing. For example, Figure 7 shows that for the given segment of road, gravelling reduces road erosion by 63 percent and sediment delivery by 56 percent. Outsloping the road without rutting reduces road erosion by 42 percent and eliminates all sediment delivery.

WEPP:Road log

Road in Boise NF

Thu October 21, 1999 10:20

Yrs	Climate	Soil	Surface	Design	Road grad	Road len	Road width	Fill grad	Fill len	Buff grad	Buff len	Precip	RRO	SRO	Sed Road	Sed Profile	Comment
30	DEADWOOD DAM ID	sand	native	inbare	4 %	60 m	5 m	50 %	3 m	25 %	50 m	823 mm	0 mm	1 mm	251.10 kg	8.53 kg	No gravel
30	DEADWOOD DAM ID	sand	gravel	inbare	4 %	60 m	5 m	50 %	3 m	25 %	50 m	823 mm	0 mm	0 mm	92.70 kg	3.81 kg	Gravel
30	DEADWOOD DAM ID	sand	native	outunrut	4 %	60 m	5 m	50 %	3 m	25 %	50 m	823 mm	0 mm	0 mm	144.58 kg	0.00 kg	Outsloped

Figure 7. *Example of WEPP:Road log file*

⬥ Rock:Clime

The Rock:Clime interface has been developed for the USDA Agricultural Research Service (ARS) CLIGEN climate generator. More than 2,000 climates from all 50 states, Puerto Rico, and the Pacific Islands are available. Rock:Clime allows the user to select climates from the database to run WEPP:Road.

Rock:Clime can be accessed either from WEPP:Road or from the FS WEPP initial screen. If it is accessed from the FS WEPP initial screen, a generated climate can be saved to any directory on the user's local computer.

If Rock:Clime is accessed from within WEPP:Road (Figure 8.), the selected climate is added to the user's 'personal' climate list. Each user can have up to five personal climates at any time.
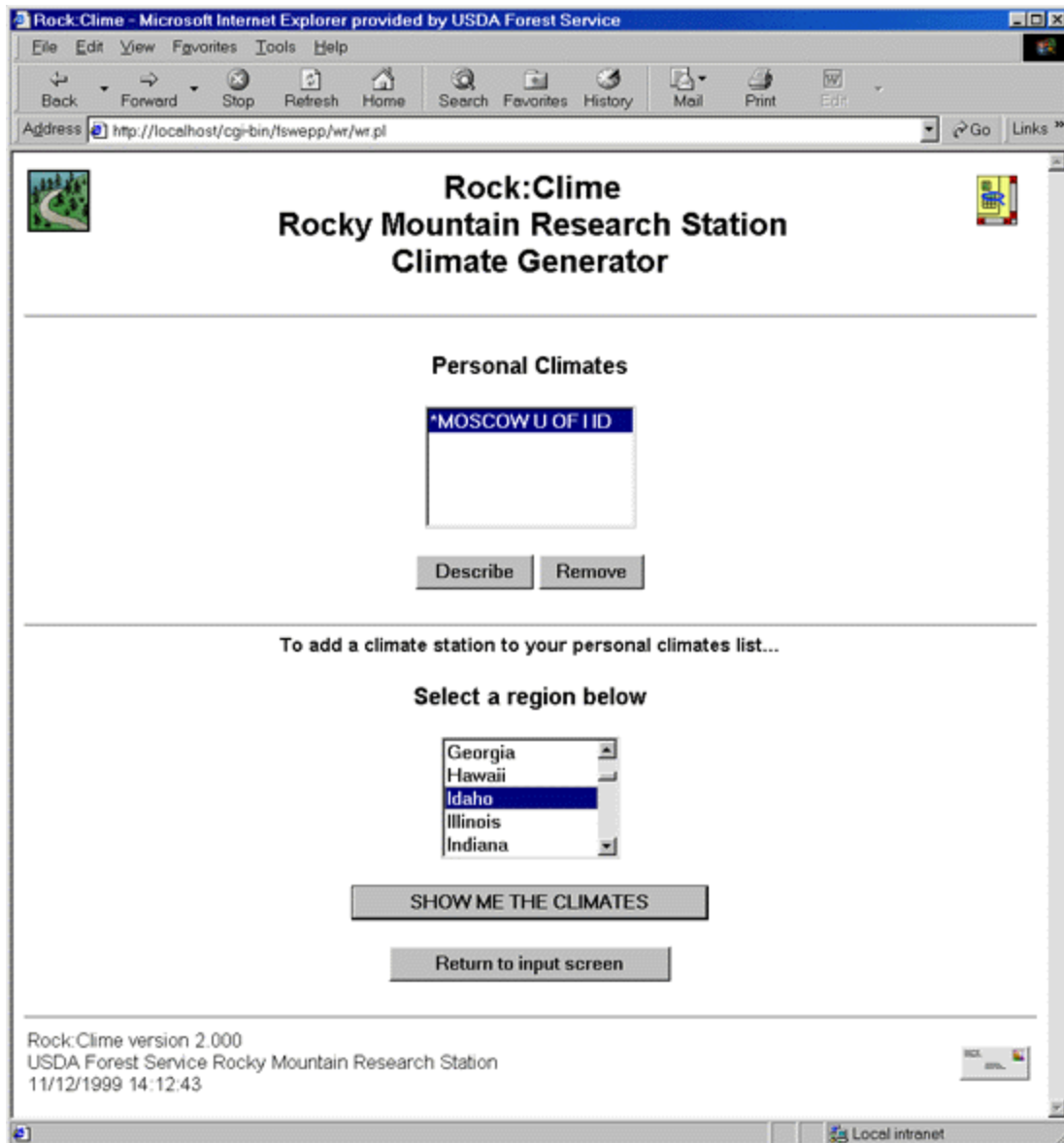
Figure 9. *Rock:Clime initial screen as called from WEPP:Road*

Description of WEPP

The Water Erosion Prediction Project (WEPP) soil erosion model is being developed by an interagency group of scientists including the USDA's Forest Service, Agricultural Research Service, and Natural Resources Conservation Service, and the Department of Interior's Bureau of Land Management and Geological Survey. Scientists from these agencies throughout the United States have been working since 1985 to develop WEPP to replace the Universal Soil Loss Equation (USLE).

The WEPP model is a complex computer program that describes the processes that lead to erosion. These processes include infiltration and runoff; soil detachment,

transport, and deposition; and plant growth, senescence, and residue decomposition. For each day of simulation, WEPP calculates the soil water content in multiple layers and plant growth/decomposition. The effects of tillage processes and soil consolidation are also modeled.

WEPP can be run from an MS DOS set of input screens or from a Windows interface currently under development. In both versions, a set of file builders assists the user in building or altering input files which can include up to 400 input variables for a single run.

⬤ Topographic Versions

The WEPP model is available in two versions. The base model is a hillslope version that predicts soil erosion from a single hillslope profile of any length. The hillslope can have a complex shape, and can include numerous soils and crops along the hillslope. Each unique combination of soil and vegetation is considered an overland flow element (OFE) (Figure 9). This feature of WEPP allows modeling the three-element scenario, consisting of a road, a fillslope, and a forest for the X-DRAIN and WEPP:Road programs.
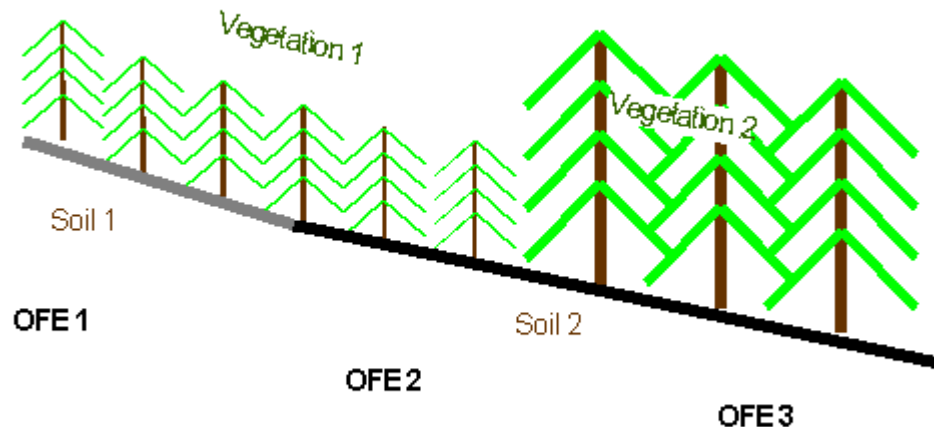

Figure 9. *Overland flow elements*

The watershed version links hillslope elements of specified widths together with channel and impoundment elements.

WEPP will model basins that have a single storm basin-wide, and where upland, rather than channel, processes dominate sediment yields. For conditions where the climate is

not uniform throughout the basin, or where channel sediment processes dominate the sediment budget, WEPP is not the appropriate model.

⬧ Input Files

The hillslope version contains four input files. A daily climate file includes the description of daily precipitation, temperatures, radiation and wind. The CLIGEN weather generator is distributed with the WEPP model to generate typical weather sequences for non-mountainous terrain from a database of almost 2,000 weather station records.

The slope file contains two or more sets of points describing the slope at intervals along the profile. The soil file can contain up to 10 layers of soil describing the texture and other physical properties of the soil. The most critical inputs are the erodibility and hydraulic conductivity of the surface layer.

The management file contains descriptions of each of the plant communities and descriptions of each of the tillage systems employed. The file also contains the surface condition at the start of the simulation.

⬧ Forest Applications

In forests, the majority of sediment comes from forest roads, and in some conditions, from skid trails or burned areas. Our research is ongoing to improve erosion prediction in forests. A set of typical templates for the MS DOS version of WEPP for forested areas and roads is available for the hillslope version from our Internet site. Templates to accompany the Windows interface are under development.

⬧ Availability

In addition to the stand-alone FS WEPP interfaces, the FS WEPP interfaces are also available for running over the Internet via the World Wide Web. The Forest Service Intranet site and can be accessed by anyone within the Forest Service network and by some other federal agencies, and typically will be faster for users within the Forest Service than will the Internet site.

FS WEPP Internet site for all users:

- http://forest.moscowfsl.wsu.edu/fswepp/

FS WEPP Intranet site for Forest Service users:

- http://fsweb.moscow.rmrs.fs.fed.us/fswepp/

The network interfaces are constantly being improved, and potential users are encouraged to visit the FS WEPP sites whenever faced with a sedimentation problem to

evaluate the usability of the site for each problem. Improved versions or upgrades of the stand-alone FS WEPP program will be announced on the web sites as they are made available.

Users are also encouraged to [send comments](#) to the FS WEPP team to be kept apprised of updates. We encourage all users to have an input into the development of more user-friendly interfaces.

For more information contact

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